

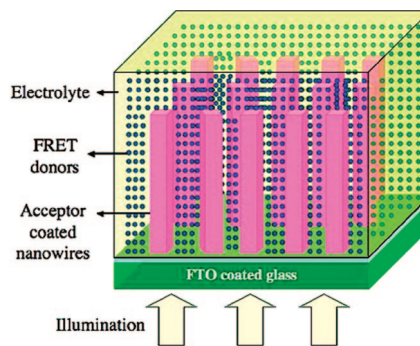
Nanowire Solar Cells Get the Red In

Modern excitonic solar cells, composed of organic compounds, dyes, gels, or liquids rather than the more conventional silicon, can efficiently harvest photons in the 350–650 nm spectral range; however, these devices typically suffer from poor quantum yields for red and infrared photons, greatly limiting their efficiency. Consequently, devices using Förster-type resonance energy transfer (FRET) have been suggested as a potential means to improve exciton harvesting. The use of FRET would bypass traditional limitations of charge separation and transport by placing the exciton close to the heterojunction interface. Solar cells based on inorganic quantum dots that employ FRET have already been proposed and demonstrated, which take advantage of this mechanism to transfer the exciton generated in the quantum dot to a

high-mobility conducting channel, such as a nanowire or quantum well.

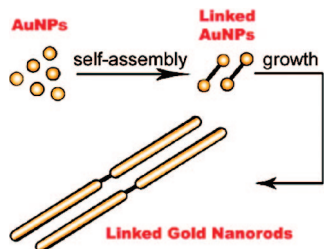
Using a similar idea, Shankar *et al.* (p 788) developed an excitonic solar cell that housed an array of close-packed rutile TiO₂ nanowires coated with ruthenium polypyridine complexes to act as FRET donors, surrounded by a solution containing phthalocyanines to act as FRET acceptors. The acceptors and donors were not tethered to each other; rather, the spatial confinement imposed by the close spacing of the nanowires within the array ensured that a significant fraction of the acceptors and donors were within a Förster radius. Experiments showed that this new device increased quantum yields for red photons by a factor of 4 for N-719 dye and by a factor of 1.5 for black dye. The authors

suggest that the use of nanomaterial devices within a confined volume could represent a new paradigm for FRET-based exciton solar cells.



Gold Nanorods Go End-To-End

Gold nanorods continue to gather increasing interest due to their facile synthesis, unique optical properties, and potential for medical and electronic applications. To take advantage of these properties, several research groups are pursuing methods to self-assemble or to arrange these nanomaterials into



useful formations. End-to-end assemblies are of particular appeal since gaps between the nanorods could serve as spacers for single-molecule electronic devices. Several successful approaches to accomplish end-to-end assembly have been reported in the literature; however, each of these approaches relies on modifying already synthesized gold nanorods by adding the desired linker agent.

Seeking a new bottom-up technique to generate gold nanorods assembled end-to-end, Jain *et al.* (p 828) developed a novel method to grow the rods directly from chemically linked seed particles. The researchers started with citrate-stabilized gold nanoparticles, then allowed these seeds to self-assemble using a water-soluble dithiol-functionalized polyethyl-

ene glycol linker. The seed particle dimers were then exposed to growth conditions similar to those typically used to form unlinked gold nanorods, extending each rod to a length of 500 nm. About 55% of the rods grown using this method were linked end-to-end. Transmission electron microscopy revealed a gap of 1–2 nm between these linked rods, a size well-suited for placing a single molecule within the gap. The linked nanorods were flexible around the hinging molecule, demonstrated by flow linear dichroism. The authors suggest that exposing the linked nanorods to a low-concentration solution of an electronically relevant molecule would result in one or a few molecules within each nanogap, enabling single-molecule electronic measurements.

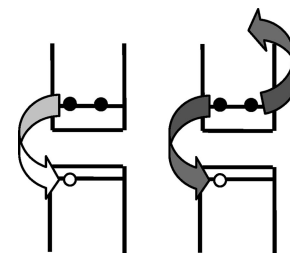
Seeing the Photoluminescent Light for Trion Decay

Adding or removing charges from quantum dots can have a dramatic effect on their optical properties. Since quantum dots have been proposed for use in a variety of applications where charges may be involved, from biology to electro-optical devices, researchers are particularly interested in understanding and predicting this phenomenon. Trions, composed of either two holes and an electron or two electrons and a hole, are a potential pathway for decay in quantum dots and have been proposed to be responsible for the off-states of photoluminescent blinking in these materials. In colloidal quantum dots, both negatively and positively charged trions have been predicted to be weakly emissive due to fast (*i.e.*, Auger) nonradiative recombination. However, researchers have also reported that films of singly or doubly charged dots had detectable photoluminescence and even a lower threshold for

stimulated emission than neutral dots, implying that trions are not very “dark.” Despite their seemingly significant role in the photophysics of colloidal quantum dots, neither the lifetime of trions nor the quantum yield has been measured in these systems.

Seeking a better understanding, Jha and Guyot-Sionnest (p 1011) used charged films of quantum dots composed of CdSe cores and CdS shells to measure the radiative and nonradiative decay of negatively charged trions. Their experiments show that the trion radiative decay rate is faster than that of the exciton by a factor of ~2.2. The researchers found that the lifetime of the negatively charged trion was ~0.7–1.5 ns for the samples measured, ~7.5 times longer than the biexciton lifetime, which may indicate that trion decay is too bright to account for photoluminescent blinking observed for quantum dots. The researchers

suggest that these results are relevant not just to models of photoluminescent blinking but also to electrically generated light from colloidal quantum dots.



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